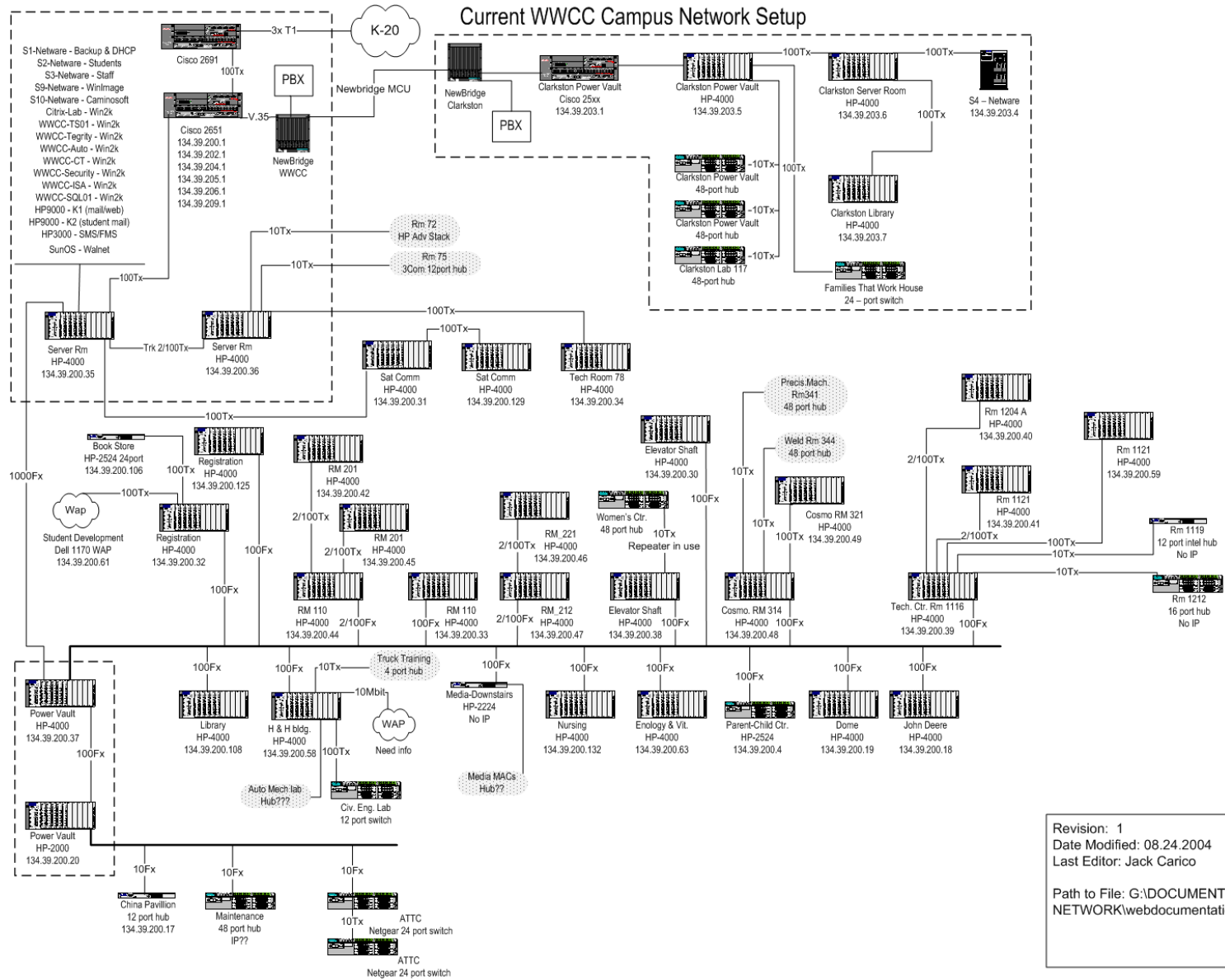# Networking/IT
A Quick Overview

CIS 81 and CST 311

Cabrillo College and CSUMB

Rick Graziani

Spring 2007

Overview

Remember, we are just beginning to herd the cats.

Much of this will become clearer LATER!

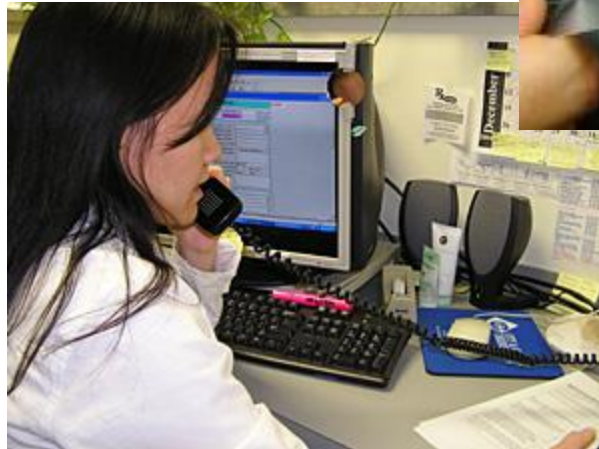The more we learn, the more all of this will come into focus!

Networks – Traditional Look

Current WWCC Campus Network Setup

Rick Graziani

3

Networks: Live, Work, Play

- Networks are no longer only used to connect computers.

- Networks are a vital part of our every day lives.

- Networks are involved in the way we live, work and play.

Networks in the way we live

- When productivity of a country increases at 1% per year, the standard of living doubles ever 70 years; at 3% the standard of living doubles every generation; and at 5% the standard of living doubles every 14 years. (Bureau of Economic Analysis and the Bureau of Labor Statistics).
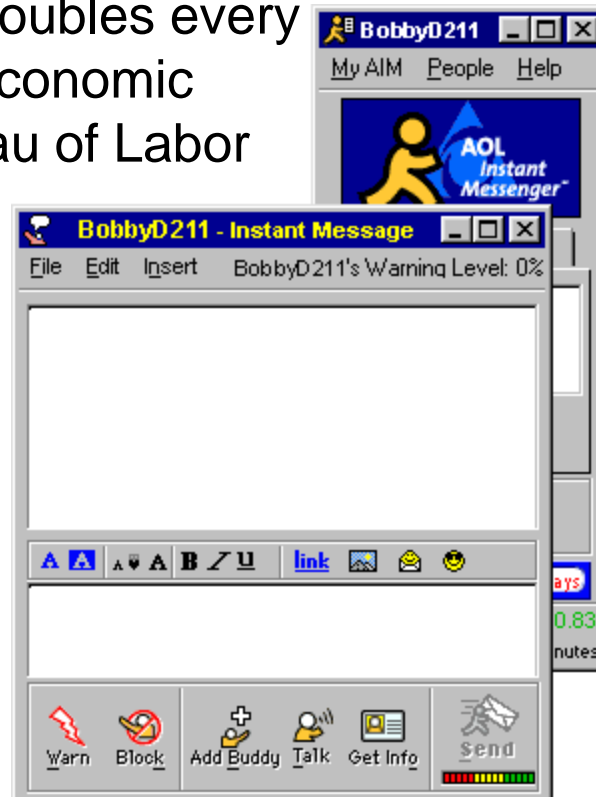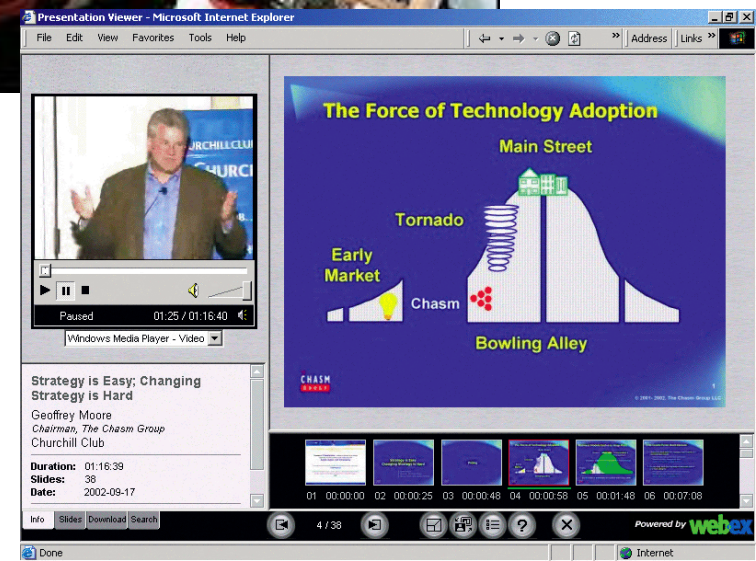
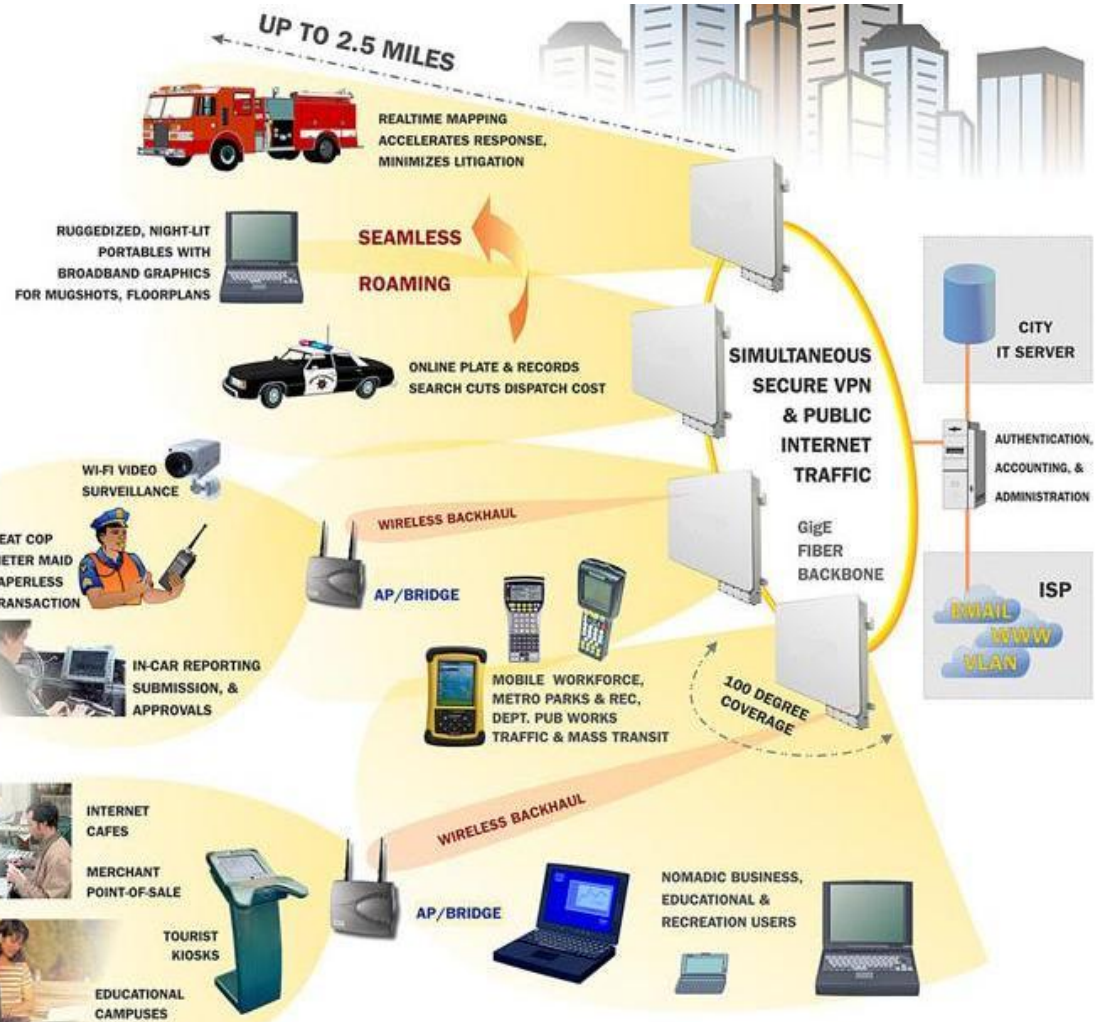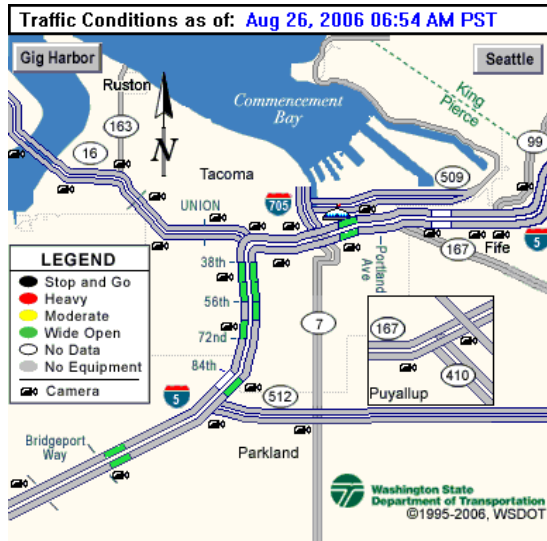# Visiting Family in Italy:
Seeing if there is WiFi here…

Networks in the way we work

- Networks are no longer just a luxury, but a necessity in conducting business for businesses, governments, educational institutions, etc.

Networks in the way we work

Traffic Conditions as of: Aug 26, 2006 06:54 AM PST

Washington State Department of Transportation ©1995-2006, WSDOT

© WSDOT   Aug 27, 2006 11:22 AM

UP TO 2.5 MILES

REALTIME MAPPING ACCELERATES RESPONSE, MINIMIZES LITIGATION

RUGGEDIZED, NIGHT-LIT PORTABLES WITH BROADBAND GRAPHICS FOR MUGSHOTS, FLOORPLANS

SEAMLESS ROAMING

ONLINE PLATE & RECORDS SEARCH CUTS DISPATCH COST

SIMULTANEOUS SECURE VPN & PUBLIC INTERNET TRAFFIC

WI-FI VIDEO SURVEILLANCE

BEAT COP METER MAID PAPERLESS TRANSACTION

WIRELESS BACKHAUL

AP/BRIDGE

IN-CAR REPORTING SUBMISSION, & APPROVALS

MOBILE WORKFORCE, METRO PARKS & REC, DEPT. PUB WORKS TRAFFIC & MASS TRANSIT

100 DEGREE COVERAGE

GigE FIBER BACKBONE

CITY IT SERVER

AUTHENTICATION, ACCOUNTING, & ADMINISTRATION

ISP

EMAIL WWW VLAN

INTERNET CAFES

MERCHANT POINT-OF-SALE

WIRELESS BACKHAUL

AP/BRIDGE

NOMADIC BUSINESS, EDUCATIONAL & RECREATION USERS

TOURIST KIOSKS

EDUCATIONAL CAMPUSES

Rick Graziani graziani@cabrillo.edu
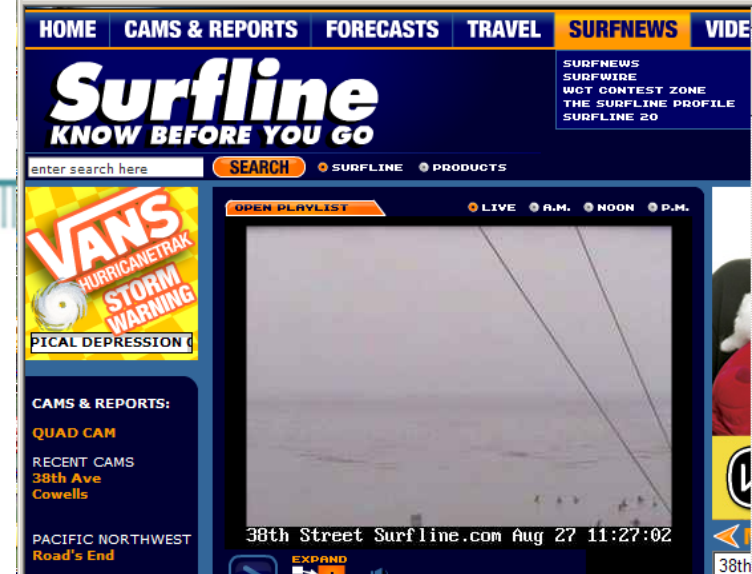
Networks in the way we play

- We rely on networks for our lives outside of work.

Networks – Behind the scenes

- More than just connecting cables… (that's the easy part)
- Today's networks are complex and sophisticated combination of protocols, software, hardware, algorithms, configurations, policies, and more
- Security
- Privacy
- 24 x 7 availability and access
- Quality of Service
- Video on Demand
- Voice over IP (over the Internet)
- Redundancy and backup
- Mission critical applications
- Productivity and user expectations
- Wireless

Convergence

- Today's networks are a convergence of:
  - Data
  - Voice
  - Video

Another look at convergence…

IT is not the network, it is the users

- The IT (Information Technology) department is not the network.

- The network is the users and their:
  - Needs
  - Expectations
  - Requirements
  - Uses

- It is not up to the IT department to decide how the network gets used, but how to meet the user requirements and at the same time provide the security and quality of service necessary.

If IT doesn't find a way, the users will!

A shift in attitude

- If an old school IT staff doesn't change, they will be replaced.
- There is too much at stake and there are IT people who can meet the needs of the users and the organization.
- Old school IT doesn't work any more.
  - We don't support MACs.
  - We can't allow that application on our network.
  - We can't give them access on our network.
  - We have too much to do already.
  - We don't support that.
  - You don't know about networks, so we can't do that.
  - That would breach our security.

Technical and Soft Skills

Cabrillo College

- Networking professionals need more knowledge and skills today than ever before.

- Tomorrow's IT professionals will need even more.

- Just as important, and sometimes even more important are the soft skills:

  – Attitude

  – Enthusiasm

  – Communications skills

  – Professionalism (conduct, etc.)

- A professional within the organization.

Example: Allowing Remote Access Support

- Remote Access Support
  - Increases availability and productivity.
  - Competitors are using it.
- IT issues may be:
  - Access
  - Security
  - QoS
- It's not a user problem, but an IT problem.
- Networking is a dynamic area where the needs and expectations of the organization change as quickly as the technology.
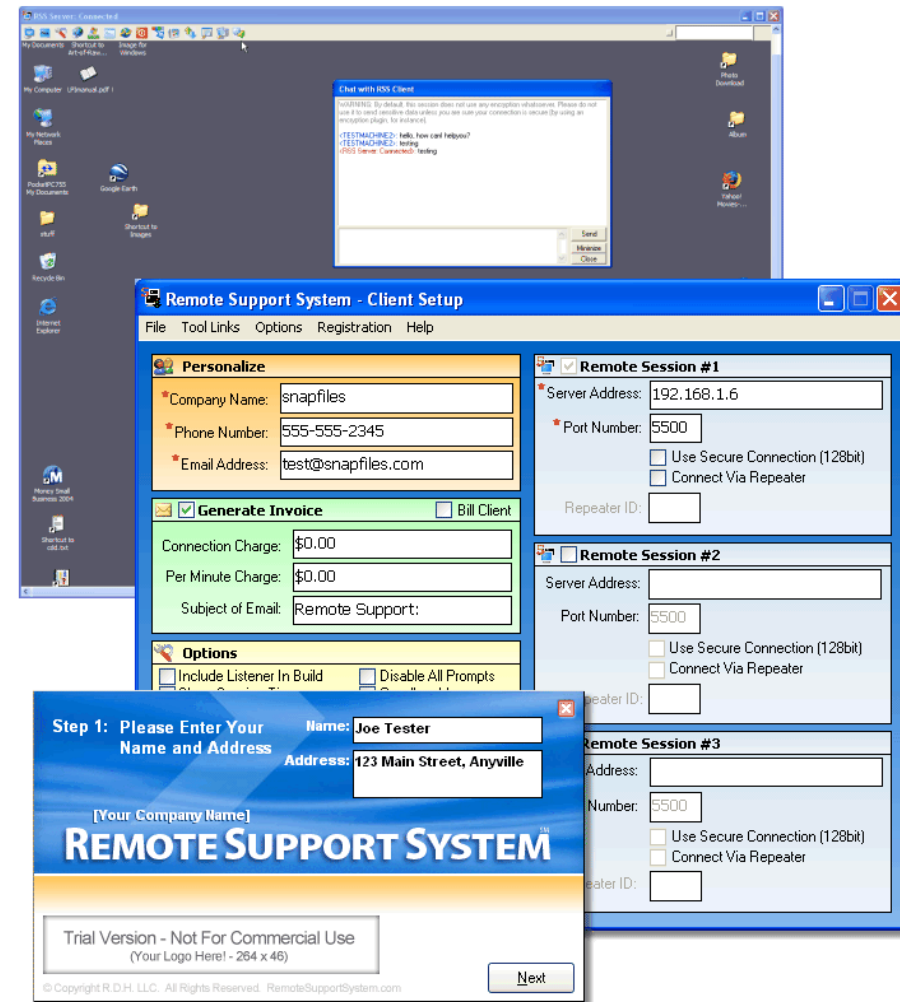
Other Examples

- Music downloads
- Myspace.com
- Blogs
- Bittorrent
- PodCasting
- Wireless
- Network Storage
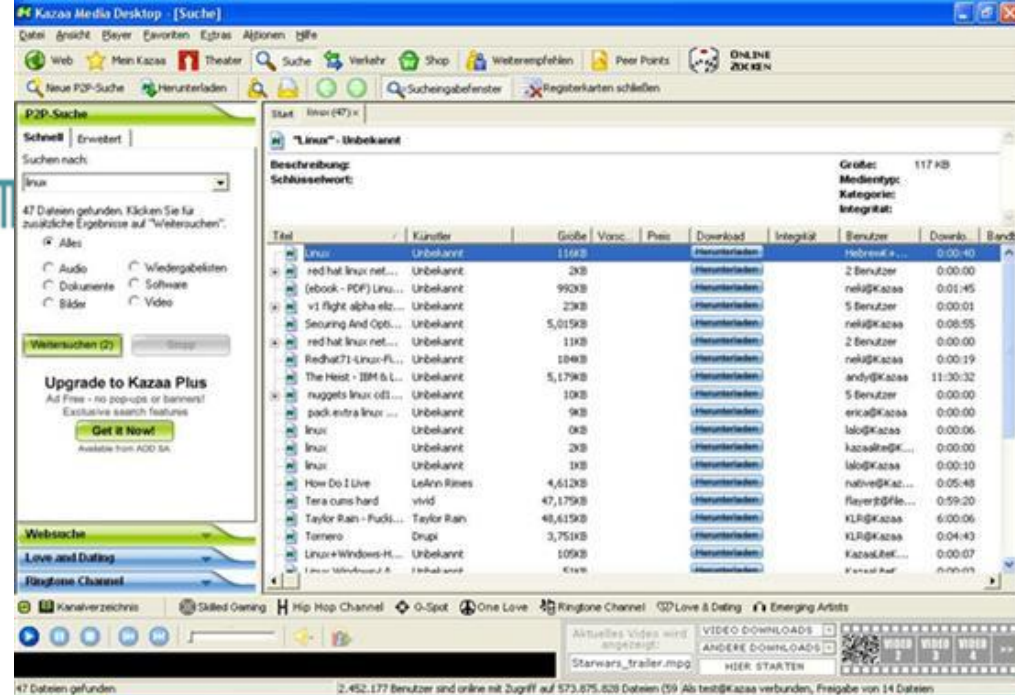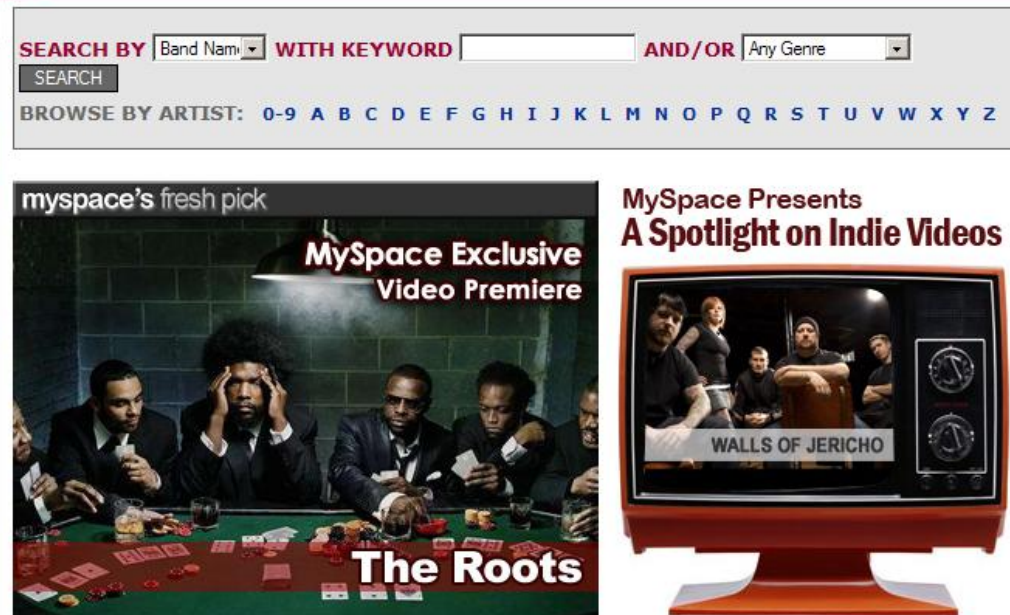
What is Networking?

Networking - the interconnection of workstations, peripherals, terminals and other devices.

Whatis.com: "In information technology, networking is the construction, design, and use of network, including the physical (cabling, hub, bridge, switch, router, and so forth), the selection and use of telecommunication protocol and computer software for using and managing the network, and the establishment of operation policies and procedures related to the network."
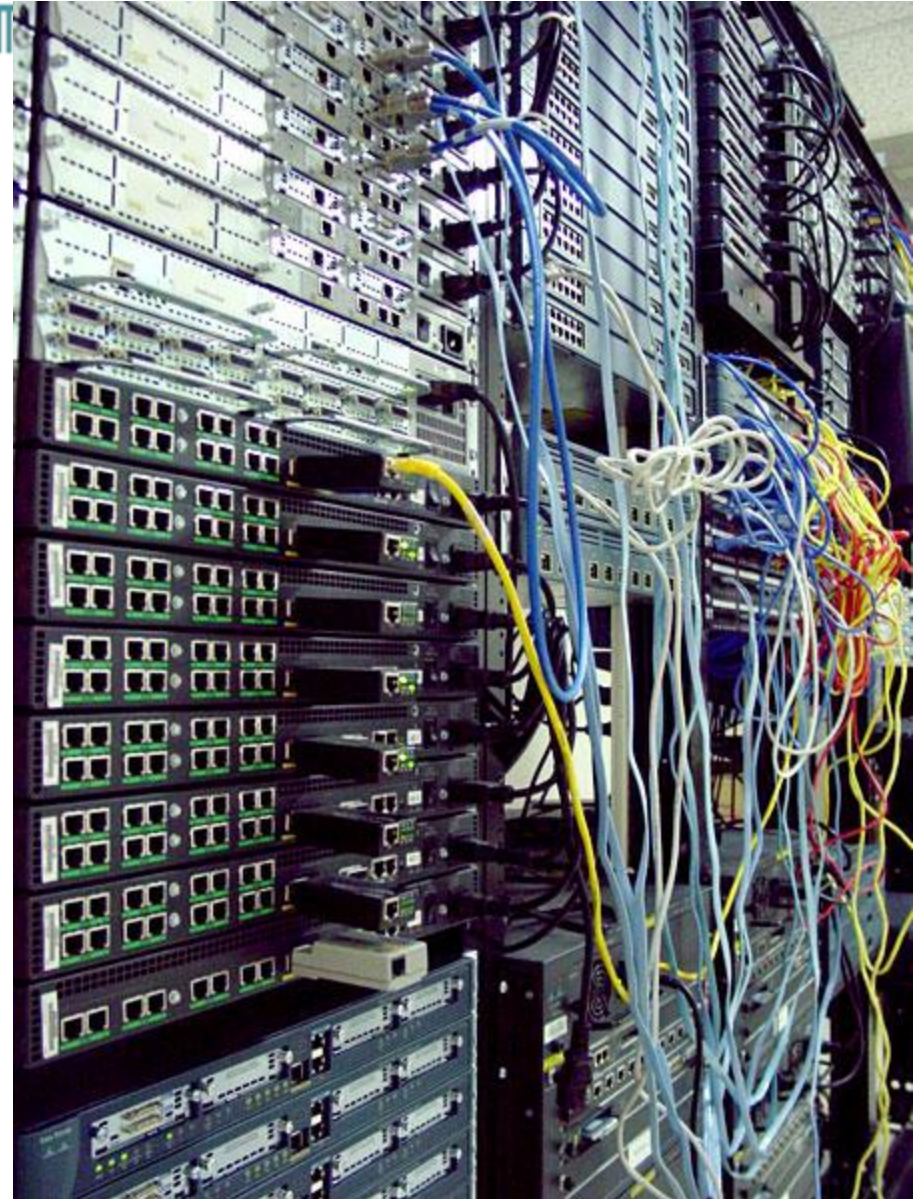
Symbols for Networking Devices
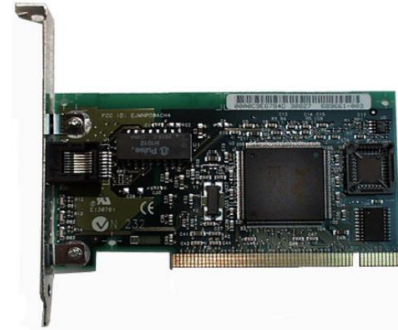
Network Devices	
Repeater	Bridge
10BASE-T Hub	Workgroup Switch
100BASE-T Hub	Router
Hub	Network Cloud

Network topologies

Physical Topologies

Bus Topology
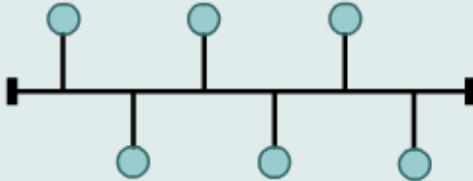
Extended Star Topology

Ring Topology
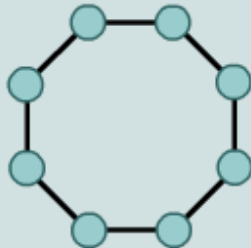
Hierarchical Topology
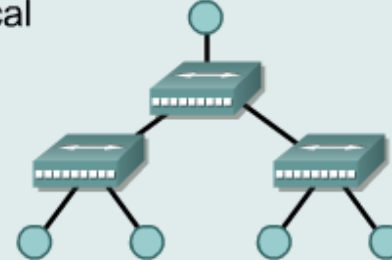
Star Topology
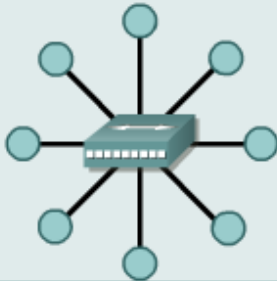
Mesh Topology

Network protocols

0		15	16	31
4-bit version	4-bit header length	8-bit type of service (TOS)	16-bit total length (in bytes)	
16-bit identification			3-bit flags	13-bit fragment offset
8-bit time to live (TTL)		8-bit protocol	16-bit header checksum	
32-bit source IP address				
32-bit destination IP address				
options (if any)				
data				
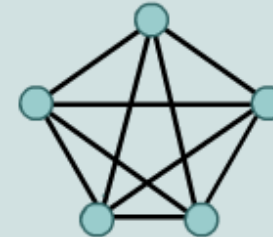
20 bytes
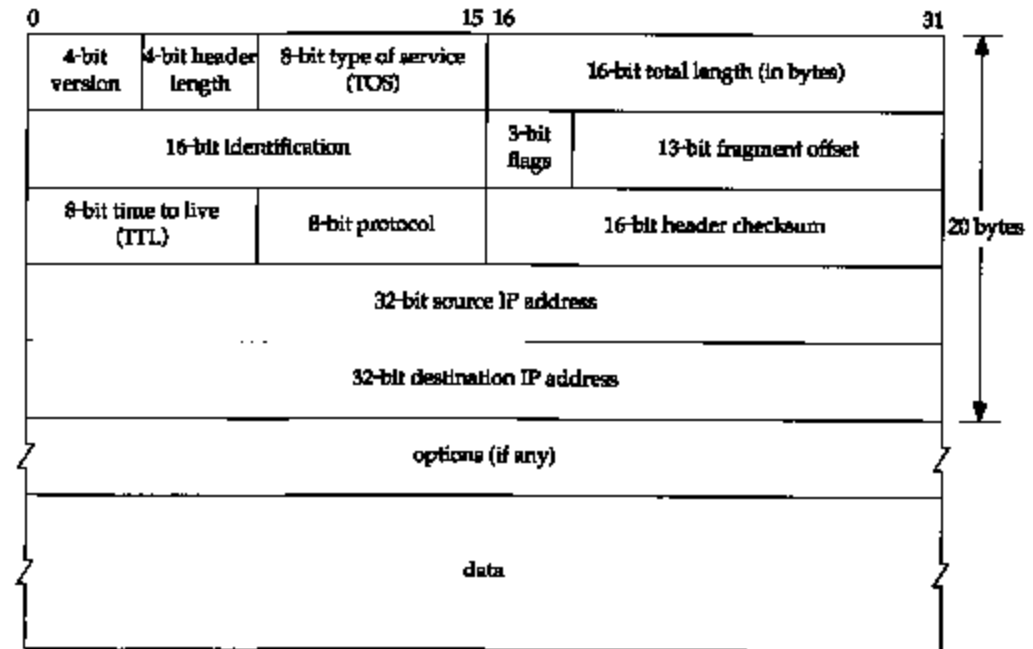
- **Protocol** - Set of rules and conventions that govern a particular aspect of how devices on a network communicate.

- **Protocol suites** are collections of protocols that enable network communication from one host through the network to another host.

- Without protocols, the computer cannot make or rebuild the stream of incoming bits from another computer into the original format.

Measurement

Unit of Bandwidth	Abbreviation	Equivalence
Bits per second	bps	1 bps = fundamental unit of bandwidth
Kilobits per second	kbps	1 kbps = ~1,000 bps = 10^3 bps
Megabits per second	Mbps	1 Mbps = ~1,000,000 bps = 10^6 bps
Gigabits per second	Gbps	1 Gbps = ~1,000,000,000 bps = 10^9 bps
Terabits per second	Tbps	1 Tbps = ~1,000,000,000,000 bps = 10^{12} bps

- In digital systems, the basic unit of bandwidth is **bits per second (bps)**.

- Bandwidth is the measure of how much information, or bits, can flow from one place to another in a given amount of time, or seconds.

ISO and the OSI Model
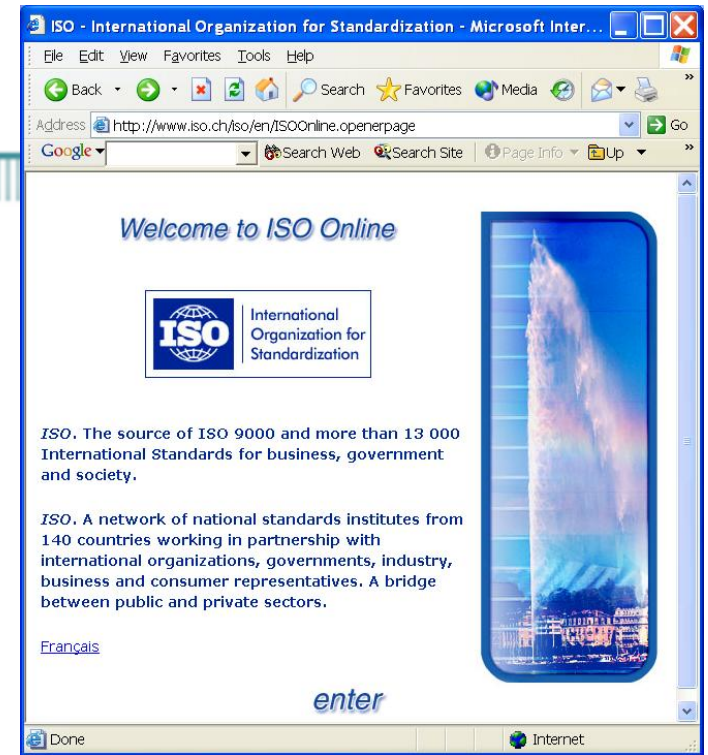
- The ***International Organization for Standardization* (*ISO*)** released the ***OSI*** *reference model* in 1984, was the descriptive scheme they created.

- **"*ISO*. A network of national standards institutes from 140 countries working in partnership with international organizations, governments, industry, business and consumer representatives. A bridge between public and private sectors."** www.iso.ch

ISO and the OSI Model
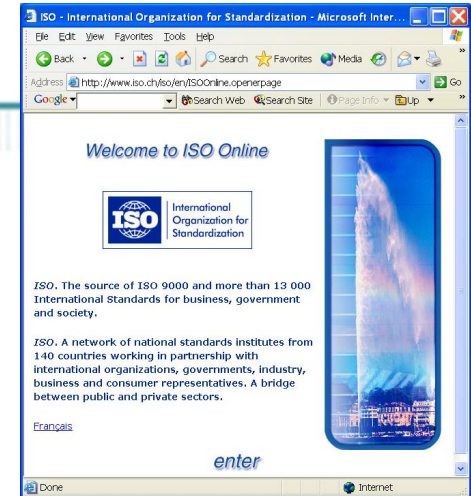
- "According to ISO, "ISO" is not an abbreviation. It is a word, derived from the Greek *isos*, meaning "**equal**", which is the root for the prefix "iso-" that occurs in a host of terms, such as "isometric" (of equal measure or dimensions) and "isonomy" (equality of laws, or of people before the law).

- The name ISO is used around the world to denote the organization, thus avoiding the assortment of abbreviations that would result from the translation of "International Organization for Standardization" into the different national languages of members.

- Whatever the country, the short form of the organization's name is always ISO." www.whatis.com

OSI Model

The use of this model can be confusing and will become clearer later!

#	Layer
7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data Link
1	Physical

- The **OSI reference model** allows you to
  - view the network functions that occur at each layer
  - a framework that you can use to understand how information travels throughout a network.
  - understand, visualize, and troubleshoot the sending and receiving data on a network
  - visualize how information, or data packets, travels from application programs, through a network medium (e.g. wires, etc.), to another application program that is located in another computer on a network, even if the sender and receiver have different types of network media
- **Note**: The Application Layer of the OSI model refers to networking applications, and not user applications.

Comtest Network Services - protocol decode chart

Comtest LA Express
Comtest NM Elite
Comtest MDA

COMTEST

7 Application

X WINDOWS, TELNET, SMTP, FTP, NIS, YP, YPBIND, NFS, MOUNT, PMAP, DNS, BOOTP, SNMP, NTP, TFTP, ND, NDS, NCP + Burst Mode, LITE, SMB, LOOPBACK, 3+Open, 3+, SMB, VSMB, DAP, MOP, NICE, LAT, CTERM, X400 MHS, X500 DS, FTAM, VTP, CMIP, RTSE, ROSE, ROSE, ACSE

6 Presentation

RPC, from IP, Function Management, COURIER, Presentation ASN.1, from TCP (CMOT), AFP

5 Session

to CMIP (CMOT), to NetBIOS, NetBIOS Emulation, SAP, NetBIOS, NetBEUI, NetBIOS Custom, NetBIOS NetBEUI, NetRPC, FOUND, SCP, DNS, Session, OSI NetBIOS, ADSP, ZIP, ASP, PAP

4 Transport

TCP, UDP, SPX SPX2, from TOP/UDP, Transmission and Data Flow Control, PEP, SPP, VSPP, VIPC, NSP, Transport TP4 TPO-3, RTMP, AEP, ATP, NBP

3 Network

ARP RARP, ICMP, to ND, BGP, OSPF, IGMP, EGP, IGRP, RIP, HELLO, RIP, NLSP, DIAG, Path Control, ERROR, RIP, ECHO, VRTP, VARP, VICP, to TP, from DRP, CONP, DDP, IP, IPX, SS#7, 0931, IDP, VIP, VFRP, DRP, CLNP, X25 PLP, IS-IS, ES-IS, AARP

2 Data Link

SLIP, X25PLP, PPP, FRAME RELAY, ALAP, SNAP, STP, DDCMP, QLLC, SMDS, HDLC, FRAME RELAY, ATM, SDLC, 802.2 (LLC), Type 1 & 2, X.21 Protocol, Border Gateway, Q921, ETHERNET v2, 802.3, 802.5, B-Channels, D-Channel

1 Physical

LAN, ETHERNET, TOKEN RING, X.21/V.11, V.24 RS-232D, V.11 RS-422, V.35, V.36 RS-1449, ISDN-BRI 1430/1431, ISDN-PRI G703, WAN

Legend

- Internet (TCP/IP)
- SUN
- Novell NetWare
- LAN Manager
- IBM-SNA
- XNS
- 3Com
- Banyan VINES
- DECnet (phase IV&V)
- OSI
- AppleTalk
- Basic
- WAN

AARP	AppleTalk Address Resolution
ACSE	Association Control Service Element
ADSP	AppleTalk Data Stream
AEP	AppleTalk Echo
AFP	AppleTalk Filing
ALAP	AppleTalk Link Access
ARP	Address Resolution
ASN.1	Abstract Syntax Notation One
ASP	AppleTalk Session
ATM	Asynchronous Transfer Mode
ATP	AppleTalk Transaction
BGP	Border Gateway
BOOTP	Bootstrap
BRI	Basic Rate Interface
CLNP	Connectionless Network
CMIP	Common Management Information
CMOT	CMIP over TCP/IP
CONP	Connection Orientated Network
CTERM	Network Command Terminal
DAP	Data Access
DDCMP	Digital Data Comms Message
DDP	Datagram Delivery
DIAG	Diagnostic
DNS	Domain Name Server (IP)
DNS	DNA Naming Service (DECnet)
DRP	DECnet Routing
DS	Directory Service
EGP	Exterior Gateway
ES-IS	End System to Intermediate System
FOUND	Foundation Services
FTAM	File Transfer, Access & Management
FTP	File Transfer
HDLC	High-Level Data Link Control
ICMP	Internet Control Message
IDP	Internetwork Datagram
IGMP	Internet Group Management
IGRP	Interior Gateway Routing (CISCO)
IP	Internet
IPX	Internet Package Exchange
ISDN	Integrated Services Digital Network
IS-IS	Intermediate System to Intermediate System
LAN	Local Area Network
LAT	Local Area Transport
LLC	Logical Link Control
MHS	Message Handling System
MOP	Maintenance Operations
NBP	Name Binding
NCP	NetWare Core
ND	Network Disk
NDS	NetWare Directory Services
NetBEUI	NetBIOS Extended User Interface
NetBIOS	Network Basic Input/Output System
NetRPC	Network Remote Procedure Call
NFS	Network File System
NICE	Network Information & Command Exchange
NIS	Network Information Services
NLSP	NetWare Link Services
NSP	Network Services
NTP	Network Time
OSI	Open Systems Interconnection
OSPF	Open Shortest Path First
PAP	Printer Access
PEP	Packet Exchange
PMAP	Port Mapper
PPP	Point to Point
PRI	Primary Rate Interface
QLLC	Qualified Logical Link
RARP	Reverse ARP
RIP	Routing Information
ROSE	Remote Operations Service Element
RPC	Remote Procedure Call
RTMP	Routing Table Maintenance
RTSE	Reliable Transfer Service Element
SAP	Service Advertising
SCP	Session Control
SDLC	Synchronous Data Link Control
SLIP	Serial Line Over IP
SMB	Server Message Block
SMDS	Switched Multi-Megabit Data Service
SMTP	Simple Mail Transfer
SNA	Systems Network Architecture
SNAP	Sub Network Access
SNMP	Simple Network Management
SPP	Sequence Packet
SPX	Sequenced Packet Exchange
SS#7	Signalling System 7
STP	Spanning Tree (IEEE 802.1D)
TCP	Transmission Control
TELNET	Telnet Virtual Terminal
TFTP	Trivial File Transfer
TP	Transport
UDP	User Datagram
VARP	VINES Address Resolution
VFRP	VINES Fragmentation
VICP	VINES Internet Control
VIP	VINES Internet
VIPC	VINES Interprocess Communication
VRTP	VINES Routing Update
VSMB	VINES Server Message Block
VSPP	VINES Sequence Packet
VTP	Virtual Terminal
WAN	Wide Area Network
X.25 PLP	X.25 Packet Level
XNS	Xerox Network System
YP	Yellow Pages (NIS)
YPBIND	Binder Program (NIS)
ZIP	Zone Information

www.comtest-int.com

Detailed encapsulation process

Destination		Source
Application	Data Stream	Application
Presentation	Data Stream	Presentation
Session	Data Stream	Session
Transport	Data Data Data	Transport
Network	Network Header Data	Network
Data Link	Frame Header Network Header Data Frame Trailer	Data Link
Physical	11000101010110110000101001	Physical

Detailed encapsulation process

Email	Data		Data
Data	Data	Data		Segment
Network Header		Data		Packet
Frame Header	Network Header	Data	Frame Trailer		Frame (medium dependent)

110001010101101100001010010101010

Bits

Warriors of the Net

- To get an idea of many of the things we will be learning about…

copyright: gunilla elam, ericsson medialab -99

copyright: gunilla elam, ericsson medialab -99

This will make much more sense later!

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